UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

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Lake Brines Yield Magnesium

Biggest project so far to develop Great Salt Lake's mineral potential is NL Industries, Inc.'s $70-million Magnesium Division Plant on the west side of the lake, 50 miles from Salt Lake City and 25 miles each from Grantsville and Tooele.

NL's scientists have figured out how to produce magnesium metal from magnesium chlorides found in the lake brines through a system of solar evaporation ponds and an electrolytic process.

The project requires railroad, highway, utilities, engineering and building construction involving some 1,200 workers; when operational late this year, the plant expects to employ 350 persons, mostly Utahns. In addition both personal and corporate taxes and other jobs in service and support industries will contribute to the State's economy.

An anticipated production of 45,000 tons of magnesium annually will make NL the second largest producer in the world. Dow Chemical ranks first with a 120,000-ton capacity.

The largest single land component consists of three solar evaporating ponds covering 33,000 acres of reclaimed lakebed in Stansbury Basin. The largest pond is 11 miles long and 8 miles wide. A fourth man-made holding pond is 1,700 feet in diameter and can store 250 million gallons of concentrated brine ready for plant process.

Aerial view of NL Industries, Inc.'s Magnesium Division Plant 50 miles west of Salt Lake City (photo courtesy of Graphics West, Inc.).

The processing plant covers 1 square mile and contains the world's largest spray-drying installation—three towers more than 100 feet tall and 30 feet in diameter.

Lake brines, five times richer in magnesium than sea water, are expected to provide a readily available source of raw material for at least the next 100 years at three times the present rated annual capacity of the plant.

Since the fundamental process in magnesium production at the Rowley, Utah, facility only involves water evaporation and because the remaining liquor from the process is not recycled into the lake, the dangers of polluting GLS are minimal.

COURT FAVORS LAND BOARD

A landmark decision of the Utah Supreme Court published September 30 eliminated a possible deterrent to development of oil-shale resources on Utah's state-owned lands.

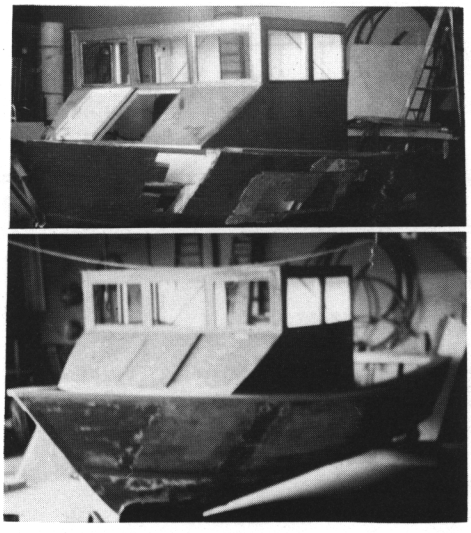
Controversy over what substances are covered in a State of Utah "single-form" hydrocarbon lease cast doubt for several years on the validity of State oil and gas and oil shale leases in oil-shale areas and conceivably could have forced drastic revision of all State land leasing.

The State's contention was that its hydrocarbon lease covered oil and gas and oil-impregnated rocks (tar sand and bituminous sandstone) only. Private interests contended that the lease also covered oil shale and they filed suit to prevent the State from issuing separate oil shale and "single-form" hydrocarbon leases.

Part of the legal controversy concerned the chemistry of the Green River Formation oil shale, a misnamed rock which is really a kerogen-rich dolomite. Fine distinctions between oil or petroleum and kerogen became important factors in the case. Utah Geological Survey personnel assisted in several aspects of the State's final technical presentation.

The State appealed two unfavorable rulings in lower courts and was unsuccessful in its first hearing before the Supreme Court. After a rehearing of the case, however, the Court in a rare reversal ruled 4 to 1 in favor of the State Land Board.

Oil shale is not oily after all and will continue to be leased separately.



Top: ruptured Clyman. Bottom: the craft rebuilt.

"Clyman" Weathers The Storm

While attempting transit of the railroad trestle in Great Salt Lake during a storm, the UGMS craft "Clyman" met with a near disastrous accident last March 19.

The craft was thrust into the sill braces of the trestle and its bottom ruptured, causing it to sink in less than four minutes.

Walter Katzenberger, skipper of the Clyman, took a line from bow and stern and tied the ship to the pilings, preventing it from sinking completely.

A passenger, H. H. Doelling, UGMS geologist, waited on the trestle's underside while Katzenberger worked his way along the trestle to shore. There he secured a rowboat and returned to retrieve Doelling.

That same evening Southern Pacific Railroad personnel with a tug assisted in salvaging the craft.

Rebuilt by Katzenberger and his crew, the Clyman will be waterborne in the near future. A happy ending to a near tragedy.

Survey Relates To The Public

In three different senses, "public relations" brings to mind *information, communications* and *public affairs*. But to Carlton Stowe, who handles public relations for UGMS, the term encompasses performance and communications to build profitable relationships with the public.

Because the Survey is enjoined to cooperate with all existing agencies to the end that geological and mineralogical resources of the State be most advantageously investigated and publicized for the good of the State, its public relations effort must be considerable.

To help tell the UGMS story, maps and panels set up at the Utah State Fair (September 9 to 19) stimulated interest and were the focal point of many discussions. Publications and samples from many of Utah's mineral industries were displayed.

A panel showing a map of oil-impregnated sandstones of Utah and the Survey's role in its development was displayed before the National Petroleum Refiners Association Western Regional Meeting held September 20 to 23 in Casper, Wyoming. Publications lists were distributed and the Survey's functions discussed.

If you need assistance concerning Utah's mineral resources, contact the Utah Geological Survey.

Committee To Study Facility

Shell Oil proposed the formation of an engineering committee representing several companies to investigate the design and related economics of a joint-venture gas gathering and processing facility to serve the northern Uinta Basin in Utah. The proposed committee would include Humble Oil and Refining, Coastal State Gas Producing, Chevron Oil, Mountain Fuel Supply, Texaco, Inc., Gulf Oil, Warren Petroleum, Flying Diamond Land and Minerals and Shell companies.

The committee would study the forecast of gas volumes, cost of gathering and compression systems, economics of gas processing, design and construction time table to determine plant size. Based on gas production forecasts supplied by the various operators, the anticipated gas production could reach 22 million cu ft of gas per day by July 1972, 40 million cu ft of gas per day by July 1973 and approximately 60 million cu ft of gas per day ultimately. These volumes are preliminary; current production slightly exceeds 4 million cu ft of gas per day.

General activity is high and larger volumes could be a reality in the near future. The engineering design of a 20 million cu ft of gas per day processing plant, expandable to 30 million cu ft of gas per day, is presently underway at Shell. Should the gas volumes materialize, the plant could be on stream by November 1972.

Ignorance Is Not Bliss...

"Environmental Geology of the Wasatch Front" was the theme of the Utah Geological Association's first annual field conference, September 30, October 1 and 2.

Three field trips—one concentrating on Salt Lake Valley, a second covering the area from Draper to Nephi and the third, between Willard and Farmington—particularly considered potential hazards caused by faulting, landslide or flooding and their effects on urban areas.

The late Ray E. Marsell, the principal lecturer on the first trip, and fellow geologists told a grim story about whole subdivisions located in potential flash flood areas, a dam, homes, high-rise apartments, aqueducts and commercial buildings built astride active faults and hillside homes partially built on improperly compacted fill that will erode and subside with time—all illustrated with life-size models!

William P. Hewitt, director of UGMS, advocated geologic planning before water systems and other public utilities are installed.

Municipality and county authorities have long considered the advisability of including geological and soil studies in their requirements for zoning.

Considered, but not acted on. Man has chosen simply to ignore the hazards.

Investigator Fulfills Needs

Investigations concerning current problems in air-water pollution, land deterioration, urban development and community living–often appearing insignificant yet of major concern with long-range environmental and economical impacts–are quietly ongoing at the Utah Geological Survey.

Often unnoticed and unrecognized, these investigations absorb time and effort with only one purpose in mind: to help a community, a county, an agency or an individual, no charge. For the most part, the results are maintained only in a report that is not publicly distributed.

The person making these investigations is fulfilling a need; he finds great satisfaction in helping others. His name is Bruce Kaliser, UGMS engineering geologist.

"Geology is destined to play a greater role in the management of Utah's environment," says Kaliser. "Geological aspects, being out of sight for the most part, are the most neglected, yet have had the most impact."

A few of the more recent projects of Kaliser include a reconnaissance of slope stability of Pine View Reservoir, Ogden Canyon, an evaluation of pollution potential of the Greater Aneth area oil field requested by the Utah Division of Health, sanitary landfill site reconnaissance evaluation, Cedar City (accepted by the Utah County Board of Adjustments), plus preliminary reconnaissances of the Kanab Creek Ranchos development, Kane County, the Buhler Estates development, west of St. George and the Patio Springs development, Weber County.

At the request of the Morgan County Commission an investigation of the geologic aspects with significant bearings on home siting and construction in Morgan County was completed.

The late Ray Marsell, consulting geologist, Utah Division of Water Resources, wrote concerning one such study "...I am impressed with the thoroughness and high quality of this excellent study. It should serve as a model for similar studies that are badly needed in other parts of the State. I congratulate both UGMS and Kaliser for this timely report on a region that is rapidly expanding and becoming increasingly popular both for homesites and for recreation."

The Survey is often asked for environmental and engineering assistance. Reports of the investigations are on open file at the Survey's office, University of Utah, and planners, public officials, agencies and interested citizens are welcome to review them.

Utah Oil Activity Grows

by Carlton Stowe
Minerals Information Specialist
Utah Geological and Mineralogical Survey

Oil and gas production is one of Utah's fastest growing industries. Since 1948, the turning point of the industry when the first commercial producer was completed in the Ashley Valley field near Vernal, Utah's wells have produced more than 401 million barrels of oil. Current monthly production is running just more than 1,650,000 barrels or about 52,700 barrels daily.

Focal point of interest this year in Utah is the new Tertiary oil trend in the deeper part of the Uinta Basin in western Duchesne County. Deep wells along this trend are finding prolific production in both Green River and Wasatch formations and the play continues to gain momentum.

The Altamont-Bluebell area should be watched closely. Shell Oil gauged a flow of 1,145 barrels of oil and 1.8 million cu ft of gas per day on initial tests of a 174-foot section between 12,310 and 14,538 feet at a well two miles south of the Altamont field discovery well. It completed a well five miles southwest of the field flowing 1,263 barrels of oil and 2.5 million cu ft of gas per day. At Bluebell, Gas Producing Enterprises opened a new play in the Wasatch completing a well flowing 1,900 barrels of oil and more than a million cu ft of gas per day. In the Cedar Rim area, Mountain Fuel Supply completed a producer flowing 426 barrels daily and at another well, Diamond Shamrock Corp. gauged a flow of 59.5 barrels an hour on tests.

Drilling is underway at Continental Oil's deep wildcat about 25 miles southwest of Vernal. This venture, costing over $1 million dollars, is expected to reach more than 20,000 feet. It will be the deepest well drilled in the 11 Rocky Mountain states. (Some 22 years ago, Superior Oil established the depth record at its Pacific Creek area 20,521-foot test in Wyoming.) A gas discovery was completed in the West Gusher oil field by Ponka Drilling and Production at a depth of 3,522 feet.

New exploration is scheduled in Wasatch County and new drilling is planned in the Coalville-Echo Canyon area, located in the thrust area of southwest Wyoming extending through Summit, Wasatch and Rich counties.

In San Juan County, Norris Oil conducted exploration six to nine miles east of the town of Bluff; Kadane and Sons Mississippian test of 4,500 feet is about 14 miles southeast of Shafer Canyon field and 24 miles northwest of Lisbon field. Several wildcats have drilled to depths past 6,000 feet in the Great Basin and Range Province and exploration is being conducted on the San Rafael Swell. Several large units have formed, including Mountain Fuel's 66,914-acre Dirty Devil Unit, Wayne County, and the Sunnyside Unit in Carbon County of 20,828 acres. The Indian Hollow Unit in the Kaiparowits Basin operated by Texaco, Inc., includes 28,876 acres.

With the upsurge of interest in the potential of the "Hinge Line" in south central Utah, companies are following

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Map Available

The U. S. Geological Survey has released on open file the "Aeromagnetic map of west-central Utah," scale 1:250,000.

The map is available at 8102 Federal Office Building, Salt Lake City, Utah 84111. At the UGMS offices, University of Utah, material from which copy can be made at private expense is available.

WGMAC REPORT: PART I

Note: The following report of the Western Governor's Mining Advisory Council was made to the Western Governor's Conference by A. C. Harding, WGMAC chairman, on July 14, 1971, at Jackson Lake Lodge. It will be presented in the *Quarterly Review* in three parts. Reprinted by permission.

TO: THE HONORABLE WESTERN GOVERNORS

Your Council welcomes this opportunity to try to put the mining industry into rational perspective. It seems especially pertinent this year to take a comprehensive look at the industry's involvement in environmental and economic problems, twin problems, which should be, henceforth, inseparable.

The environment is one of the most publicized practical and political problems of the seventies. Perhaps never before has there been such widespread public participation in political processes. Certainly never before has the mining industry faced such a multiplicity of proposals to legislate, regulate, and even to eliminate. Unfortunately, as in most times of crisis, some of the loudest voices shouting frenetic solutions would create more problems than they propose to solve. Aggravating the real problem are some people whose main purpose seems to be aggravation. For some it is apparently self-fulfilling to "Cry 'Havoc' and let slip the dogs of war" against all industries, all construction, all environmental changes. Despite the sincere zeal of many to remedy undesirable situations immediately, we need to take a rational look at the total picture.

The Environment

Even some industry leaders, encountering belligerent audiences, have felt impelled to pledge an impossibility, an undisturbed environment. Dr. Pecora, Under Secretary of the Interior, responds that environmental changes are inevitable. He mentions tremendous natural processes, such as an annual precipitation on the face of the U. S. of 4 million tons of salt, and says that more particulates have fallen on the earth from three volcanic eruptions than from all of man's activities. We know, also, that each of us changes the environment by existing, by using and polluting some part of it. Our concern, therefore, is not just with environmental change, but with avoidable degradation, not just with pollution, but with unnecessary pollution.

Mining Involvement

The problem stems not primarily from the mining industry, but from two concurrent, continuing factors, the tremendous population growth, and man's seemingly insatiable appetite for energy. These two factors have combined over the last 25 years to increase electrical energy consumption by six times and gasoline energy sixteen times. Most of the energy is created, as is animal and human energy, by combustion, and combustion always produces waste products. These factors, products, and the resulting problem cannot be attributed directly to the mining industry, but the industry acknowledges, partly because now it must, increased responsibility to not unnecessarily contribute to the problem.

The mining industry is part of the problem because mineral deposits are part of the environment. The miner has always been especially cognizant of environment. The location of his mine and operating procedures are dictated or influenced by his immediate environment, which often has been hostile to his survival, and sometimes has terminated it drastically. The environment is not a new factor in mineral industry decisions, but, today, as in all industries, in all engineering projects, it is a newly emphasized factor, because environmental concerns have expanded beyond previous horizons.

A southwestern governor has told mining companies in his state that the cost of removing pollutants must be part of their cost of doing business in that state. Miners in all states now know that this factor and others are of increasing importance in making operating decisions. One state's new 'Department of Economic Planning and Development' has already indicated that such factors will include aesthetic value, recreational value, historic, fish and wildlife, urban development, and agricultural values. Today's miner will not be inclined to ignore such values, partly because he will not be allowed to, but, also, because the miner, too, is part of the public, and hopefully concerned with the heritage he bequeathes to his own posterity.

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closely any drilling activity which may take place. Phillips Petroleum's three wells are scattered from a mile and a half east of the town of Wales and six miles east of the town of Salina to some nine miles east of Nephi. Another major oil company has plans for drilling in the vicinity of Richfield. A lease play started last year has swelled to more than two million acres over virgin and complex geological areas of this part of the State. Moderate to steady leasing is still taking place. Meanwhile, at the only major oil field in southern Utah to date, Upper Valley field, Tenneco Oil completed the twenty-ninth well in the field flowing 1,542 barrels of oil per day.

Shell Oil has dominated most of the Indian land lease sales in the Uinta Basin since the Tertiary oil play along the trend started. A Salt Lake City independent, A. T. Jones, however, paid $396.66 an acre for a 40-acre tract in the Altamont area in September. Several other companies were active in this sale. Chevron Oil filed oil and gas lease applications on some 137,000 acres in eastern Utah's Emery and Grand counties. Texaco, Inc., was also high bidder at a State lease sale on two tracts in Grand County.

Wildcat drilling this year has increased over the previous year. On October 1, 1971, 37 wildcats were drilled against 27 the year before. There are 21 "million-barrel" oil fields in Utah, 12 of which are located in San Juan County, six in Uintah County and one each in Duchesne, Garfield and Summit counties. Five gas fields in Utah have produced more than 100 billion cu ft of gas.

Many of the world's giant oil fields have been located along such areas as Utah's "Hinge Line" or the Uinta Basin's "Tertiary Trend." Thus, more than ever, Utah is a target for exploration. . .since by and large, the State is relatively unexplored.

We are, or should be, grateful to many of those people who are environmentally concerned, but it seems certain that the mining industry must forever remain incompatible with those who profess concern only for a natural en-

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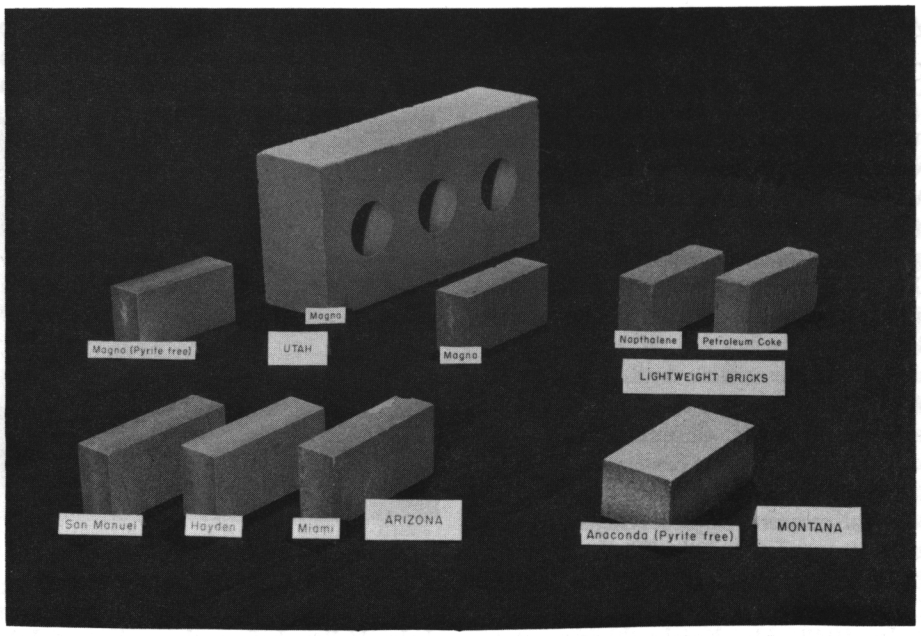
Tailings Reclaimed

The current emphasis on environmental problems has focused attention on the massive nationwide accumulations of mine, mill and smelter wastes that represent potential air and water pollution hazards. By stabilizing or utilizing these wastes, the pollution hazards can be reduced or eliminated.

Laboratory research[1] at the U. S. Bureau of Mines in Salt Lake City demonstrated that building bricks meeting ASTM standards for commercial construction grades can be produced from waste copper mill tailings.

Tailings representative of the types being discharged by the western porphyry copper producers were obtained from five sites – Hayden, Miami and San Manuel, Arizona, Anaconda, Montana, and Magna, Utah. In laboratory tests they were dried in an oven at 110° C and screened through 20 mesh to break up lumps, as were the additives before being blended with the tailings. For green strength, 0.5 percent lithium calcium lignosulfonate was added.

Following mixing, the blend was prepared for pressing by slowly adding water and mixing by hand to prevent lumping. Specimens measuring 1½ x 3 inches in cross section and between 1 and 1¼ inches thick were pressed at 5,000 psi, fired at 200° C for about six hours and soaked for two more hours at the firing temperature. After cooling, the linear shrinkage, water absorption and compressive strength of the specimens were determined.



Building bricks from copper mill tailings (photo courtesy U. S. Bureau of Mines).

Subsequent tests to study the effects of varying forming pressures, curing times and additives showed (1) a forming pressure of 5,000 psi and (2) a soaking time of two hours at a maximum firing temperature of between 1,120° and 1,175° C to be preferable.

All the bricks produced using 99.5 percent tailings and 0.5 percent calcium lignosulfonate at the foregoing conditions met the following ASTM standards:

Percent		Saturation Coefficient	Compressive Strength (psi)
Shrinkage	Water Absorption		
8.0	17-22	0.78-0.88	2,500-3,000

Utilization of mill tailings on a commercial scale would eliminate the need for digging new pits, conserve natural resources and simultaneously remove potential sources of air pollution.

Aside from the environmental advantages, the economics of producing and marketing bricks made from mill tailings are favorable. A production cost estimate prepared by the Coal Research Bureau of West Virginia University showed the estimated cost of producing 1,000 bricks from mill tailings to be $33.64. Compared with an anticipated market value of $80 per 1,000 bricks, this indicates an attractive return on investment, transportation costs of bricks or tailings to be considered.

[1] Pigott, P. G., E. G. Valdez and K. C. Dean, 1971, Dry-pressed building bricks from copper tailings: U. S. Bur. Mines Rept. Inv. 7537, 13 p.

Data Compiled

Up-to-date comprehensive information on all important minerals–metals, nonmetals and fuels–is available in the U. S. Bureau of Mines "Mineral facts and problems, 1970 edition." Industry patterns, technology (present and future), by-product-coproduct relationships, consumption patterns, economic factors and environmental considerations are discussed for individual minerals in separate chapters. Also, the outlook for each mineral is projected to the year 2000. Cost, $10.75 or complete set of individual chapters, $15.80 per set.

Cores Cataloged

Several thousand pounds of chips and cores received from Gulf Oil Co. and Phillips Petroleum have been cataloged and placed in stacks at the Survey's Sample Library and Annex.

D. Craig Mann, curator, has incorporated the material in a new consolidated index to samples, cores, electrical and other mechanical logs and lithologic logs filed in the library.

Publication of the catalog as a Survey circular will be in the near future.

Quasi Moon Land

As part of their preparation for lunar exploration, the Apollo 15 crew carried out detailed practice missions earlier this year in the Rio Grande Gorge near Taos, in north central New Mexico, a site with striking similarities to the lunar landing target, Hadley Rille.

Following a close examination by scientists of the USGS Center of Astrogeology, aided by geologists from the New Mexico Bureau of Mines and Mineral Resources, the rugged, moon-like

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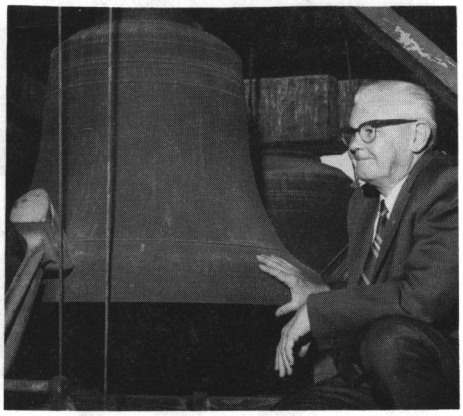
Auditor-Historian Preserves Heritage

"How much is heritage worth?" asks Newell Knight, Salt Lake City's Deputy Auditor and Historian, in his *History of Washington Square*, a report largely responsible for the Salt Lake City and County Building's placement on the National Register of Historical Sights. The Salt Lake City coat of arms plaque hanging on his office wall, the drawers of yellowed documents dating into the middle 1800's, the pamphlet on his desk of quotations from Governor Brigham Young are all indicative of Mr. Knight's personal concern in preserving the colorful heritage of Salt Lake City.

In 1948, Mr. Knight, then a state senator, first began compiling information for tourists concerning historical sights and events. During the past twenty years, he has collected and organized numerous invaluable historical records—documents, for example, showing that no murders took place in Salt Lake Valley before the arrival of Johnson's Army, reports and maps of some of the first recorded geological surveys in Utah, records of the nineteen companies organized to protect the water rights of the early settlers. Is Salt Lake City's Lindsey Gardens the first recreational garden in the United States, rather than the supposed Boston Sandbox? From his records, the city historian would argue "yes."



Knight aside the gold alloy bells which chime in the tower of the City and County Building.

Besides directing the erection of many historical monuments, talking weekly about Salt Lake City's past with tourists from New York to Sweden, working actively with U. S. Veterans organizations and supporting projects such as the International Peace Gardens, Mr. Knight hopes to receive enough financial backing to compile and publish a complete history of Salt Lake City.

Anyone who enjoys studying the earth's past by crawling through muddy caves would find an historically oriented tour guided by Mr. Knight through the dusty top rafters of the City and County Building an unforgettable experience.

EARTHQUAKE EPICENTERS

General earthquake epicenters in or near Utah for April, May and June 1971, with dates of occurrence and approximate magnitudes, are listed below. Unless otherwise indicated, localities are in Utah.

		Magnitude
April		
2	East of Randolph, Utah, in Wyoming	<2.0
2	Near Cedar City	<2.0
2	Near Devil's Slide	<2.0
6	Near Strawberry Reservoir	2.0
6	Near Bear Lake	<2.0
7	South end of Utah Lake	2.0
7	South of Sunnyside	2.1
7	Near Coalville	<2.0
8	Near Hiawatha	2.1
9	East of Randolph, Utah, in Wyoming	1.6
12	Near Emery	1.9
13	East of Randolph, Utah, in Wyoming	2.4
14	Near Rangely, Colorado	2.4
14	East of Randolph, Utah, in Wyoming	2.4
16	Near Emery	2.1
17	South of Sunnyside	2.3
19	Near Ephraim	2.3
19	Near Ephraim	2.0
20	Near Fayette	3.1
20	Near Fayette	1.5
21	East of Randolph, Utah, in Wyoming	2.3
22	East of Randolph, Utah, in Wyoming	2.4
22	Near Levan	3.2
23	Near Manti	2.3
23	Near Manti	2.0
23	Near Manti	1.8
24	South of Sunnyside	2.2
26	Near Levan	<2.0
28	Rangely, Colorado	2.3
29	East of Randolph, Utah, in Wyoming	2.2

(Approximately 9 recognized rockbursts near Price, Utah, were of significant size to be recorded, and 9 significant Bingham blasts.)

May		
1	Central Utah-Nevada border	2.4
4	Near Santaquin	<2.0
4	Near Huntsville	<2.0
6	South of Sunnyside	<2.0
6	North of Bear Lake in Idaho	2.6
6	Near Castle Rock	1.8
7	South of Sunnyside	<2.0
7	South of Castle Dale	<2.0
7	East of Randolph, Utah, in Wyoming	2.4
10	Near Huntsville	1.8
11	South of Castle Dale	<2.0
12	Northeast of Randolph, Utah, in Wyoming	2.5
13	Near Santaquin	2.0
13	East of Randolph, Utah, in Wyoming	2.1
14	East of Randolph, Utah, in Wyoming	2.4
20	East of Bear Lake	2.4
21	Near Bear Lake	2.1
23	North of Manila, Utah, in Wyoming	1.8
24	East of Randolph, Utah, in Wyoming	1.8
24	Northeast of Farmington	1.8
24	Near Manti	1.9
25	Near Manti	1.7
25	East of Randolph, Utah, in Wyoming	2.7
26	East of Randolph, Utah, in Wyoming	2.4
26	East of Randolph, Utah, in Wyoming	2.4
26	East of Richfield	1.7
27	East of Salt Lake City	2.6
28	South of Price	1.7
29	South of Emery	2.2
31	Near Ephraim	2.4

(Approximately 7 recognized rockbursts near Price, Utah, were of significant size to be recorded, and 15 significant Bingham blasts.)

June		
1	East of Randolph, Utah, in Wyoming	2.2
1	Near Devil's Slide	2.5
2	East of Randolph, Utah, in Wyoming	2.3
2	East of Randolph, Utah, in Wyoming	2.3
3	Near Bear Lake	2.3
3	Near Pleasant Grove	2.9
3	Near Utah Lake	2.3
4	East of Randolph, Utah, in Wyoming	2.5
6	Near Echo City	2.3
7	Near Coalville	2.0
8	Near Pineview	2.0
8	East of Randolph, Utah, in Wyoming	2.7
10	Near Woodruff	<2.0
11	Near Scofield	2.2
11	Near Scofield	3.0
11	Near Scofield	3.2
12	Near Moroni	<2.0
12	South of Sunnyside	<2.0
14	Near Pleasant Grove	2.1
15	Near Strawberry Reservoir	<2.0
15	Near Cedar Fort	2.4
16	Near Salt Lake City	1.5
19	Near Gunnison	2.2
22	Near Mona	2.5
23	Near Gunnison	3.3
22	Near Richfield	<2.0
25	Huntington	2.8
25	East of Randolph, Utah, in Wyoming	2.2
25	East of Randolph, Utah, in Wyoming	<2.0
30	East of Randolph, Utah, in Wyoming	2.3
30	Near Bear Lake	2.5

(Approximately 4 recognized rockbursts near Price, Utah, were of significant size to be recorded, and 16 significant Bingham blasts.)

These earthquakes were recorded by the University of Utah seismograph stations under the direction of Kenneth L. Cook. All locations and magnitudes are preliminary determinations; the final determinations will be printed in the University of Utah Seismological Bulletin, issued quarterly.

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vironment at the expense of man's total environment, which includes economic, social, cultural and home environments. Protection of the environment cannot be absolute, but must be modified by the need for production from the environment, and vice versa. Bertrand Russell wrote years ago, "The problem of survival means in the first place that man must try to bend the forces of nature to his own will." Despite any conflicts, the mineral industry and a viable progressive ecology can and must exist together. Twenty-five hundred years ago Pythagoras and other Greek philosophers developed the idea that harmony and existence itself depend upon a balanced adjustment of opposing tendencies. Opposing tendencies are reconciled in the laws of physics and nature and must be in the art of politics. We suggest that the greatest continuing challenge in our legislative halls and administrative offices is to beneficially balance man's two opposing desires, for security and liberty. Encouragingly, the state department previously mentioned has announced that the state should not try to separate environmental planning from economic planning. Another western governor has been quoted as saying, "Man does not live by bread alone, but he does not live on scenery, and pure air and pure water alone" and has often expressed his concern for "the total quality of life." He has also called for continuing development of our mineral resources, without deterioration of the environment. In a strict sense, it may be that we can't have the one without the other, and the relativeness of the two must be weighed in balance, under a precept stated in Emerson's essay on 'Compensation', that for everything we get we have to give up something.

The mining industry has factors peculiar to it. Because it is an extractive industry, the miner is necessarily involved in creating waste products, sometimes of terrific proportions. A copper mine may recover only 8 pounds of copper from 2,000 pounds of ore, and move an equal volume of barren rock to reach ore. A gold mine, to recover a pound of gold, may treat 80,000 to 100,000 pounds of ore. Disposal of waste products is a continuing problem. In some operations there can result improvement to the initial environment, except in the opinion of the purist naturalist, who sees disaster in any disturbance of the pristine pattern. In other operations some waste is put to beneficial use, or returned underground, but the net effect is some degradation. The total for all mining operations may be only a fraction of one percent of the degradation effected by such things as the nation's highway construction or home-building, and the effect of some mines on the ecological part of the environment may be less than a single automobile's lifetime destruction of birds, rodents and insects.

The mining industry has long practiced conservation, at least that part of it concerned with blending low-grade ore, not usable or profitable alone, with higher grade ore, to produce more usable materials in the long run. It must be noted, here, that any unnecessary tax, royalty, or environmental increment added to the cost of producing low-grade ore contributes to the economic possibility that some minerals may be left forever, unmined. A guideline was stated in 1908 by a great conservationist, President Teddy Roosevelt, in a letter to a mining engineer, "No effort should be made to limit the wise and proper development of these resources; Every effort should be made to prevent destruction, to reduce waste, and to distribute the enjoyment of our natural wealth in such a way as to promote the greatest good of the greatest number for the longest time." The mining industry's contribution to that greatest good will be essayed later in this report.

(continued on page 8)

Apologies To Author

Bulletin 90, "Landslides of Utah," by J. F. Shroder, Jr., carries two spelling errors of the author's name – on the cover and frontispiece pages. The first page of text shows it correctly.

For the anguish this caused Dr. Shroder and the inconvenience to librarians, the Survey expresses its sincere regret.

...To The Dogs

From the Soviet Union comes a story by the Associated Press that dogs are being used as geologists.

Reportedly the dogs successfully sniffed out ore deposits in experiments conducted near the Finnish border. They discovered ore in bogs and under nearly 18½ inches of snow, finding all deposits marked on the map. European sheep dogs appear to be the best for the job while hunting dogs and fox terriers do poorly because they are easily diverted by rabbits and other game. The dogs are being used to ferret out deposits of sulphurous pyrite, emerald and malachite.

Incidentally, it only takes about 4 or 5 months to train a dog to be a "geologist" whereas 4 years of college are needed for a human to qualify!

Recent Releases

Utah Geological and Mineralogical Survey published three new studies in the preceeding three months:

Bulletin 90, "Index to the Salt Lake Mining Review, 1899-1928," by C. W. Warren. All claims, lodes, placers, mines and other mining properties in Utah that were referred to in the *Review* are included and each reference to each property is listed. Each mine or prospect is followed from year to year, even to name changes, and identified with a mining district so that the extent of information may be readily determined ($3.00 over-the-counter or $3.30 mailed).

Bulletin 91, "Landslides of Utah," by J. F. Shroder, Jr. The causes and distribution of landslides and their relation to slope exposure, climate, rock type and age are extensively researched and compiled in this bulletin. Of the approximately 600 landslides identified in Utah, twenty-eight individual landslides and four landslide zones in which individual landslides cannot be distinguished are described ($2.50 over-the-counter or $2.75 mailed).

Water-Resources Bulletin 16, "Nonthermal Springs of Utah," by J. C. Mundorff. Data on about 4,500 nonthermal springs are presented. Locations are given on colored maps and tables and major springs in selected areas are described ($4.00 over-the-counter or $4.40 mailed).

They can be ordered from Utah Geological Survey, 103 UGMS Building, University of Utah, Salt Lake City, Utah 84112.

(continued from page 7)

Our industry has not been blameless by any means, during the years in which environmental problems have been developing, but, now, from mining areas in every state come announcements of plans to correct and minimize damage to the environment, with special regard to water, land and air.

Water

Problems created by some eastern coal mines, with acid mine waters, have tarnished the image of all mines, although similar conditions are relatively rare in the west. Mine-water problems exist. It might be noted that some mine waters are harmless, others less harmful than permissible discharges of municipalities, that some mines develop and provide water which otherwise would not be developed, and that water can be more harmful to a mine than the mine to the water.

The Bureau of Mines has reported that nationally the amount of water used by the mineral industry comprises only two percent of that used by all industries, and has noted that water used in mining is quite productive. In the eleven contiguous western states, average gross value of mineral production is $3,250 per acre-foot of new water used, or 100 times as much as from the acre-foot used to produce a ton of alfalfa, perhaps valued at $30. The water used by the miner is also more expensive. The average cost of Nevada's mineral industry is over $32 per acre-foot, far above the agricultural economic range of $3 to $6. That causes the miner to recirculate water wherever and as often as possible. Nevada's Carlin gold mine, for instance, discharges no water, and the only loss is to evaporation. Where water is discharged, it is now closely scrutinized, and when necessary treated for minimal ecological damage. For example, plans to improve water discharges will cost several million at Anaconda and $5.6 million at Homestake.

Land

Through the Mining and Minerals Policy Act of 1970, the Congress and the President recognized that mineral deposits of economic value are relatively rare, have to be mined where they are found and require less surface area than most other land uses. The mining industry must damage some surface lands, but a year ago, one western governor reported that the total damage in his state, since mining began, was less than that utilized for sand and gravel excavations needed for highway construction alone. Among causes of past land degradation have been state laws encouraging some discovery work to be done with bulldozers, scarring surfaces, and actually wasting work so far as mineral development was concerned. Some improvement has been effected by substituting drill holes, through recommendations of the industry. The industry is not yet united on further substitution by filing survey notes or a map in lieu of physical discovery work, although in at least one state a start is being made toward mapping existing mining locations. About one-half of all states have now adopted Land Reclamation Laws. Considerable federal legislation is being proposed, some of it unnecessarily restrictive and potentially disastrous. Public Land Law Review Commission recommendations, also, will result in many proposals for modification of general mining law. Some of those proposals already have mining industry endorsement, others will not be resisted, but some will require analysis when more definitely formulated. That Commission has recommended retention of a location-patent system to keep public lands open for exploration in the public interest. The mining industry has long opposed abuses of the intent of present mining laws and seeks to cooperate in correcting them.

Air

Particulate matter is an obvious type of air pollution, and all industries are trying to reduce or eliminate visual emissions. Smelter operators, and some coal burning power plants, have special technological problems involving modifications for sulphur-dioxide emissions. For years methods have been sought to convert sulphur-dioxide to elemental solid sulphur. Present capabilities convert it to sulphuric acid, only partially satisfactory because of limited demand. One state alone could produce an annual excess of almost two million tons of sulphuric acid, and storage would be a staggering problem and safety hazard.

Hopeful for the future are many things, such as accelerated experiments in hydrometallurgy, a wet process in lieu of smelter combustion, and in development of geothermal sources and processes for power generation. Both governmental and private agencies are involved. The Bureau of Mines, for instance, is developing a wet process for recovery of mercury, and it seems safe to predict a wet process will be developed for copper. However, there will be an appreciable time lag for further engineering, pilot plant construction and testing. In the meantime, smelters are investing heavily toward reducing emissions at existing operations. For example, during the last 6 years Phelps Dodge has contracted, completed, or programmed $42 million for air pollution. Magma Copper is spending $50 million for a new type of smelter. It is reported that all industries will average something between $4 and $10 billion a year for the next five years to help solve pollution problems. Smelting capacity in this country has been curtailed. Some companies are compelled to ship concentrates to foreign smelters, with obvious impact on domestic employment, tax dollars and balance of payments.

There is no doubt in the mining industry that air standards are being imposed with little regard for economic and overall social consequences. Some standards have been confirmed by the Bureau of Mines as being improper conclusions based on unsubstantial data. It should be noted that air quality analysis and assessment is a science in its infancy. There are many questions to be answered, involving not just the quantity of emissions, but the effects on ecological and other environmental increments. To help secure some answers, one western state mining association last year made a grant of more than $545,000 to establish an 'Atmospheric Analysis Laboratory' at its state university.

(Part II in next issue of the *Quarterly Review*)

Moon Maps Sold

Lunar features with the focus on Apollo 15's landing site just a mile or so from Hadley Rille at the foot of the 12,000- to 15,000-foot Apennine Mountains are geologically depicted on USGS's Map I-723, two sheets.

The multicolored maps with explanations (36 inches x 50 inches) are produced at two scales—medium and large—to emphasize both the regional and local geology of the landing site. They are available for $1 per set from the Distribution Section, U. S. Geological Survey, 12000 South Eads Street, Arlington, Virginia 22202 (prepayment required).

Course Focus: Environment

To provide an opportunity to study and to observe the relation between man and his geological habitat with emphasis on earth processes that affect man, Westminster College, Salt Lake City, Utah, is offering an "Environmental Geology and Geologic Hazards" course during January 1972.

Bruce N. Kaliser, UGMS engineering geologist and assistant professor of environmental geology, and Richard S. Kopp, associate professor of geology and chairman, Department of Earth Sciences, Westminster College, will staff the course; guest speakers also will be invited to participate.

The course is designed for regular college students and for professional people engaged in such fields as urban planning, earth sciences, land management, site selection, agricultural sciences, resource planning and development, landscape architecture and engineering.

It offers three options:

(1) A study of the basics of geology as applied to environmental studies (January 3-7, 1972),

(2) Application of theory as applied to geologic hazards and the environment (includes eight evening lectures, morning discussions and afternoon field trips; January 10-19, 1972) or

(3) A field trip to study environmental problems associated with major dams and reservoirs, ground subsidence, hillside development, earthquake faulting, etc., to southern California with stops in Utah and Nevada (8-day continuous, January 20-27, 1972).

For further details on the entire course (four hours of college credit, tuition $200; for audit and certificate upon completion, tuition $100) or any phase (evening short course of eight lectures, tuition $20; trip to southern California, transportation fee, $40 estimated), contact the Department of Earth Sciences, Westminster College, 1840 South 13 East, Salt Lake City, Utah 84105.

Uinta Faults Described

A paper entitled "Faulting on the North Flank of the Uinta Mountains, Utah and Colorado," by Howard R. Ritzma, UGMS petroleum geologist, appears in the recently published 23rd annual field conference guidebook of the Wyoming Geological Association.

The great faults along the Uintas—North Flank, Henrys Fork, Uinta and Sparks—are described as reverse faults ranging in dip from 81° to 0° depending on area. The faulting is bracketed in a span of 5 to 10 million years in latest Paleocene through medial Eocene time. Three sections illustrate the faulting, two in areas where wells penetrate the faults and provide accurate measurement of dip.

Ritzma concludes that the reverse nature of the faulting with preservation of thick Cretaceous and early Tertiary sediments beneath the overriding thrust sheets provides conditions favorable for oil and gas entrapment in areas along the Uintas at present untouched by exploratory drilling.

Tar-Sands Delineated

Examination last summer of possible tar-sand deposits in the Hill Creek extension of the Ute Reservation, Uintah County, by Ann and Gordon Blair yielded negative results.

The man and wife team, both from Newark University, Rutgers Branch, and both presently working towards their masters in geology at the University of Utah, established the western limits of the Hill Creek deposits.

Gordon Blair's graduate work is focused on the unzoned Cretaceous-Tertiary boundary in the Desolation Canyon area on the Green River.

His wife's studies on the Keg Mountains, a complex volcanic area with economic possibilities in uranium, beryllium, copper, manganese and other minerals, cover a 7½-minute topographic quadrangle.

The Survey is financing all three phases of the Blairs' research and has provided a field vehicle.

Land Sliver Dispute

Whether or not they know it Utah and Idaho citizens are in dispute over three-tenths of a square mile of real estate along the border between Box Elder and Cache counties, Utah, and Oneida County, Idaho. The sliver of *terra incognita* is about half a mile east of U. S. 191 where the line between the states jogs slightly from its east-west direction.

The indefinite boundary is shown on the newly issued Henderson Creek, Idaho-Utah topographic quadrangle map. The northerly zig of the boundary which would favor Utah with 185 or so added acres is shown as the "Hanson State Boundary Survey of 1896". Idaho's claim is staked on the "Sonnenkalb State Boundary Survey of 1898" which zags the line to the south.

The ground in question includes the summit of the 7,057-foot Sheep Dip Mountain, some rugged terrain, one spring and much complicated geological structure in Cambrian and Tertiary rocks. Cache County's slice of no-man's land is about 20 acres.

Whelan Resumes Post

On leave since July 1969 for a tour of duty in the U. S. Navy on Guam, J. A. Whelan, University of Utah professor and UGMS research geologist, returned to the states last August 1971.

His resumed duties at the Survey will be devoted to supervision of Great Salt Lake projects with emphasis on completing a lake bottom chart, scale 1:125,000, and to mining districts. In the near future, he plans to complete two studies held in abeyance since his departure: (1) on brine characteristics of GSL, 1966-1969, and (2) on the Star Range, Millard County, with the focus on economic geology.

Whelan also teaches part-time at the University.

UGMS staff members, who check in advance all new topographic maps issued by the U. S. Geological Survey, also noted two graves located about 1,500 feet west of the disputed sliver of ground on the Idaho side of the line—Sonnenkalb's and Hanson's?

(continued from page 5)

area was chosen as an ideal outdoor real-scale classroom, where USGS teams organized a series of traverses and exercises scheduled to be closely duplicated on the moon.

The land surface adjacent to the Rio Grande Gorge is gently rolling and covered with gravels of several distinct characteristics corresponding to the rolling cratered lunar mare (sea) surface and its veneer of rubble. Both the gorge and the lunar rille are entrenched in basalt lava flows and, although the walls of the gorge are probably steeper than the walls of the rille, areas of talus (a heap of broken rock) and slumping are present in both features.

Hadley Rille is one of more than 300 winding lunar valleys termed "sinuous rilles" which greatly resemble narrow valleys on earth eroded by running water. Although the origin of the lunar rilles is still debated, the rilles generally are considered to have formed by the action of fluids—water, gases, mobilized volcanic ash and lava. The available evidence at Hadley Rille appears to favor the concept of a collapsed lava tube of enormous proportions if judged by terrestrial standards. The lava that formed the rille is presumed to have been very fluid and present in large volume, permitting a large long lava tube to form. The roof of this tube partly collapsed after the lava drained from it and remaining portions of the roof were then destroyed by meteorite bombardment.

During warm-up exercises at the gorge, the Apollo 15 astronauts and back-up crew worked exactly as though they were on the moon, navigating a training rover vehicle along a prescribed route marked on maps, photographing features and landscapes, taking cores, digging trenches and testing a variety of communications and support equipment. Care was taken that even the angle of the sun at their backs was the same as at Hadley Rille.

Hadley was the only rille visited during the lunar exploration program; thus, it looms as a particularly significant target. Samples taken from it should yield information unlike that gathered in previous landing missions and provide a better framework of knowledge for theories about the origin and evolution of the moon.

Core Permits Issued

As the first step toward development of the oil-shale resources of Colorado, Utah and Wyoming, the U. S. Department of Interior announced that it will issue permits for informational core drilling on public (federal) lands in the oil-shale regions of these states. Applications may be filed until early in 1972.

The core drilling is to be conducted by individuals, companies or groups of companies to enable them to nominate potential lease sites, which in turn are to become the areas where experimental and pilot development programs will be undertaken in future years. The entire program is subject to close scrutiny and regulation as to its possible effects on the environment of the region.

To early October 1971, no applications for informational coring permits were received for Wyoming and Utah lands. A number of permits have been requested in western Colorado and activity appears to be centering there.

Utah's prospects for participation in the program appear dim at present. Most companies are reluctant to commit funds until the question of Utah's entitlement to federal lands in the Uinta Basin has been settled. In contrast, no such uncertainty exists in the Piceance Creek Basin of western Colorado where the region's richest, thickest oil shale occurs.

Utah's selection of lands from the public domain includes about 150,000 acres in the southeast Uinta Basin covering most of the lands considered desirable for open-cut or underground mining of oil shale. If favorably acted on, the selection would give Utah control of a potential resource of immense value.

'Old' Data Desired

In the early days much work was frequently done in now abandoned mining districts.

Maps, drill-hole data and assay data from these old workings sometimes furnish valuable information. From mere outlines of workings a trained geologist often can infer what the ore controls were and how much ore was mined. From assay data, grade can be evaluated. Such maps made available to rescue forces could be extremely valuable in locating a child or rock hound who falls into or explores and becomes lost or trapped in abandoned workings.

Old underground workings are often inaccessible because of caving. Ore controls, favorable stratigraphy for ore, character and grade of ore, which help to evaluate the future potential of the district, are unknown until after underground investigation.

For these reasons, old mine maps, assay data and drill-hole data are desired. Any person with data to donate can contact J. A. Whelan, research geologist, UGMS, 510 Mineral Sciences Building, University of Utah, Salt Lake City, Utah 84112 (581-6636).

If a donor wishes to retain the originals, copies will be made. The material will be placed on open file and occasionally used in publications unless the donor requests they be returned, confidential for Survey use only.

The announced discovery of a large coal deposit about 10 miles west of Escalante in Garfield County by Woods Petroleum Co. verifies existence of widespread coal reserves in the Kaiparowits. Development awaits a market.

Holdings Increase

Ute Indians at the Uintah-Ouray Reservation recently conducted their Ninth Annual Resources Tour with the emphasis on the natural resources of the area.

The three-day tour covered activities of the new Bottle Hollow Resort, Ute Fab, Western Analytical Lab, Livestock, Outdoor Recreation Enterprises and oil and gas development.

R. O. "Rex" Curry, director of the resources for the tribe, pointed out that financial holdings have increased from $8 million to $10 million in the last four years, which has significantly increased employment among the 1,650 members of the Ute tribe and other residents of the area.

Major areas of growth have been in oil and gas development, livestock operations and the motel-resort complex.

Cloudbursts Flood Minersville

Record floods—the worst in 30 years—centered on Minersville last August 21st.

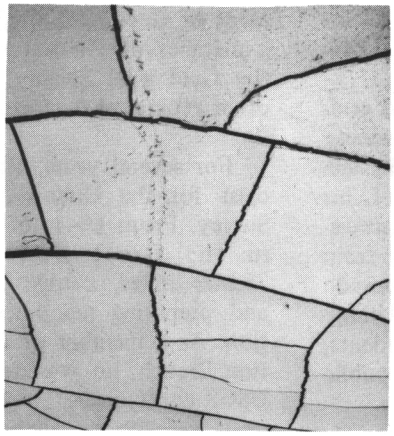
Two and two-tenths inches of rain and hail were recorded at a gage in Minersville between 5:00 and 5:30 p.m.; a bucket west of town collected two and one half inches.[1] Flows of about 5,000 cfs were measured in natural and artificial drainages in the area. The east drainage of Red Hills Reservoir experienced flood flow greatly in excess of the "100-year flood."

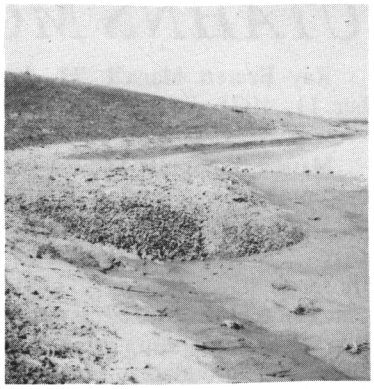
Hail, followed by intense rain, resulted in peak runoffs from the combined volumes. It is estimated that the Red Hills debris basin prevented damage that would have amounted to quarter of a million dollars to Minersville town and the surrounding area. Another debris basin at Big Wash, the next major drainage south, prevented another tenth of a million dollars in damage. As it was, some $30,000 in damage was sustained, spread out over roads, fences, a school, fields, irrigation systems, stock grounds and homes and yards, in approximately that order.

Cloudburst activity seemed to center on Yellow Mountain just northeast of town. The bare rock outcrop shed water like a duck, depositing over three feet of rock debris on Highway 21.

Flash flooding this summer was not confined to Beaver County; occurrences were reported in Piute, Garfield, Sevier, Sanpete, Tooele and Salt Lake counties as well.

[1]Figures courtesy of U. S. Soil Conservation Service.





Top: delta fan in flood-control canal. Result of single flash flood at Minersville. Left: bird tracks across expanse of mud deposited in flood-control structure above Minersville.

Bruce Kaliser, UGMS engineering geologist, investigated a few of the more major occurrences to study their effects on urbanization. Mudflows, which form potential substrata for later real estate developments, are being studied from the point of view of their frequency and engineering characteristics. The Survey has embarked on a soils testing program in support of this endeavor.

Concomitant with the sediment load factor is the erosion of the watersheds involved. Why some watersheds are more prone to erosion than others also is being studied.

Solutions to these questions are particularly important in Utah where canyons border on almost all population centers. Increased urbanization inevitably encroaches on the alluvial fans of successive flood debris and mudflow deposits.

S. High Plateaus Investigated

Few studies of the geology of the southern High Plateaus have been published since C. E. Dutton's pioneer work in 1880. He established that the plateaus consisted of tilted fault blocks made up largely of Mesozoic sedimentary rocks and Cenozoic sedimentary and volcanic rocks and that the plateaus' structures were transitional in nature from those of the Basin and Range Province on the west to those of the Colorado Plateau on the east.

Even on the most recent geologic maps much of the area of the Markagunt Plateau and Tushar Mountains is shown as undifferentiated Tertiary volcanic rock.

J. J. Anderson, Department of Geology, Kent State University, along with his colleagues and students, has been investigating the Cenozoic geologic evolution of the southern High Plateaus, Utah, since 1963. In a bulletin published by the Geological Society of America[1], he abandons the established Brian Head Formation of the area as a formal stratigraphic unit and includes in it units better defined and understood as formations in their own right.

During the early and middle Tertiary, extensive volcanic activity formed a volcanic pile many thousands of feet thick in the southern High Plateaus area. In late Oligocene and early Miocene, the regional volcanic activity ceased and was marked by the accumulation of volcanic arenite and associated clastic sediments in and around what is today the northern Markagunt. Anderson defines the rock stratigraphic unit thus formed as the Bear Valley Formation.

The Bear Valley Formation was deposited in an extensive structural and physiographic basin within which faulting and volcanism were contemporaneous with sediment accumulation. Little volcanism accompanied the early stages of sand deposition; the later stages, however, were marked by local eruptive activity which admixed a considerable quantity of glass shards in the sand and produced local ignimbrite and tuff strata.

Deposition of the arenite was accomplished mostly by the wind, and took place under arid climatic conditions. This is indicated by the mineralogy and texture of the sand and by the large-scale cross-bedding throughout most of the section.

Two clearly defined sandstone members can be recognized within the Bear Valley Formation; each of them sheds light on the geologic history of the area of deposition. The formation crops out over an area of more than 1,000 square miles and has a maximum exposed thickness of 1,000 feet. It is characteristically moderately to well sorted, fine- to medium-grained, zeolite cemented submature to mature volcanic arenite. No fossils have been recovered from this rock unit.

[1]May 1971, v. 82, no. 5, p. 1179-1206.

Cooperative Formed

Some 25 independent miners and claim holders in the area surrounding Moab, Utah, formed the Four Corners Minerals Resource Cooperative to provide prospectors and developers with maps, geology reports, owners' names, etc. on a variety of minerals. Interested persons may contact the secretary, Keith Barrett, in Moab.

UTAHNS MOURN GEOLOGIST

Ray Everett Marsell, 77, died October 11, 1971, in Salt Lake City, Utah.

Marsell, a popular and respected geology professor, taught at the University of Utah from 1927 to 1962. His lectures, fascinating because of his thorough understanding of and enthusiasm for geological subjects ranging from "Powell's Exploration of the Colorado River" to "Cloudburst Floods in Utah," influenced not only classroom students, but also audiences attending his public lectures and geological field trips.

Richard Logan, leader of the Transcontinental Excursion of the International Geographical Congress (1952) wrote Prof. Marsell, "There are various aspects of the local geology [of the Salt Lake area] that I shall never forget—the recent fault scarps cutting the moraines of the beach lines about the Oquirrh Range. You made these remarkably clear and interesting to the group. . ."

"Geomorphology of the Salt Lake Region," a paper given by Prof. Marsell at a regional conference of the Geological Society of America, is one of the many reports he presented at such conventions.

Marsell received his B.A. (1929) and M.S. (1932) degrees from the University of Utah; in 1957 he was awarded an honorary degree in professional engineering by the University of Utah Department of Geological Engineering. He was a member of Phi Kappa Phi, Sigma Xi, the Geological Society of America and other geological organizations.

For several years, Marsell was a geologist for the United States Geological Survey. From 1941 to 1943, he worked in the Great Basin—travelling over 75,000 miles, studying geomorphology and preparing manuscripts for publication. As a member of the Water Utilization Branch, he attended and conducted USGS conferences.

From 1931 to 1971, he made systematic geological studies of Utah's most important groundwater basins as a geological consultant for Salt Lake City Corporation Metropolitan District. Since his retirement from the University in 1958, he was affiliated with the Utah State Division of Natural Resources.

At the age of 77, he continued to share his talents as teacher, researcher, writer and field surveyor. Only two weeks before his death he attended the Utah Geological Associations' annual field trip as a guide, enriching his geological presentations with personal anecdotes and quips.

Marsell actively supported the Utah Survey and did much to publicize the merits of its investigations. His passing represents a great loss to the Survey's staff.

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THE UNIVERSITY OF UTAH
SALT LAKE CITY, UTAH 84112

Address correction requested

U of U Scientist Attends Conference

In attendance at the two-week conference of the International Union of Geodesy and Geophysics held in Moscow, USSR, August 1-14, 1971, was University of Utah's Kenneth L. Cook, professor of geophysics and director of the U of U's seismograph stations.

He presented a paper, co-authored by N. W. Major, professor of geophysics, Colorado School of Mines, to a symposium on the forerunners of strong earthquakes. The paper, entitled "Secular Strain Measurements near the Wasatch Fault, Utah," correlated changes in strain and tilt of underground earth blocks with earthquakes in Utah.

The general assembly of the IUGG meeting was attended by some 2,500 scientists representing associations from all over the world.

QUARTERLY REVIEW
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